(3)

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21F 11/00 — A1

(11) International Publication Number: WO 96/31647

(43) International Publication Date: 10 October 1996 (10.10.96)

(21) International Application Number: PCT/EP96/01484

(22) International Filing Date: 4 April 1996 (04.04.96)

(30) Priority Data:
VE95A000009 7 April 1995 (07.04.95) IT

(71) Applicant *(for all designated States except US)*: CARTIERE CARIOLARO S.P.A. [IT/IT]; Via Provinciale, 41, I-35010 Carmignano di Brenta (IT).

(71)(72) Applicant and Inventor: TRANI, Giorgio [IT/IT]; Giudecca, 671, I-30100 Venezia (IT).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: CARIOLARO, Norberto [IT/IT]; Via Provinciale, 41, I-35010 Carmignano di Brenta (IT).

(74) Agent: PIOVESANA, Paolo; Corso del Popolo, 70, I-30172 Venezia (IT).

(81) Designated States: AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published

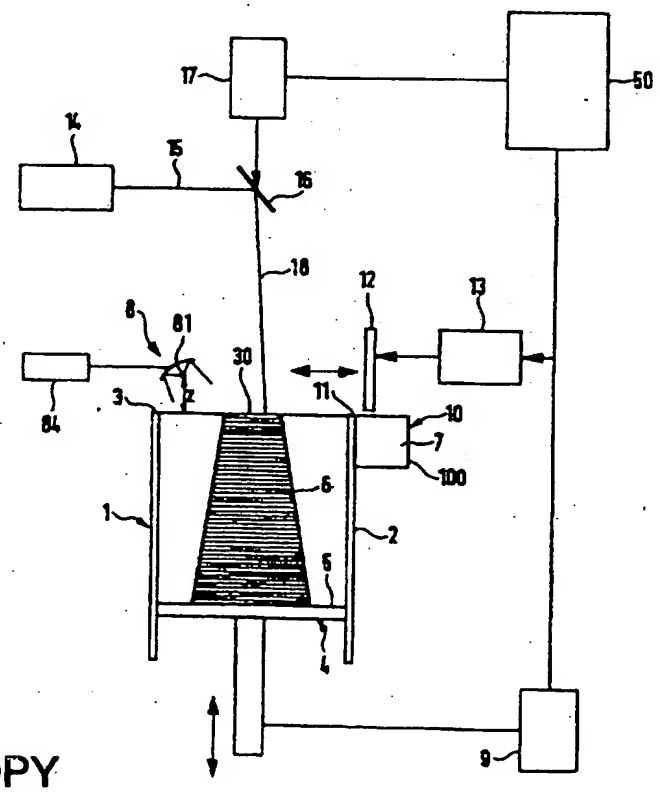
With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD FOR PRODUCING YIELDABLE PAPER AND PLANT FOR IMPLEMENTING THE METHOD

(57) Abstract

A method for producing yieldable paper, characterised by comprising the following stages: (a) feeding a mix of vegetable fibres to a kneader member (1); (b) mixing the mix with water in the kneader; (c) beating (6) the fibres by rubbing, to obtain a pulp having a degree of beating of at least 30 °SR; (d) transferring the beaten pulp into a flow chest (10); (e) feeding the beaten pulp from the flow chest onto a paper web formation cloth (12) with consequent reduction of the water percentage by gravity and vacuum; (f) pressing (14) said web, with consequent further reduction of its water content; (g) initial drying (16) of the preformed paper web to a substantially constant moisture content of between 15 % and 65 %; (h) compacting between pairs of rollers (17), of which one is of hard material comprising surface ribs and driven at greater speed, and the other is of soft material with a smooth surface and driven at lesser speed; (i) final drying (18) to a moisture content of between 15 % and 4 %, preferably 10 %-8 %; (j) glazing (39).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia
AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgystan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakhstan
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam

METHOD FOR PRODUCING YIELDABLE PAPER AND PLANT FOR IMPLEMENTING THE METHOD

This invention relates to a method for producing yieldable paper and a plant for implementing the method.

An object of the invention is to provide a method enabling paper to be produced with a high degree of strength while at the same time with a yieldability both in the longitudinal direction and in the transverse direction of practically the same order of magnitude.

A further object of the invention is to provide a method enabling paper to be produced with a continuous plant.

These and further objects which will be apparent from the ensuing description are attained according to the invention by a method for producing yieldable paper as described in claim 1.

To implement the method a plant is provided as described in claim 16.

A preferred embodiment of the present invention is described hereinafter with reference to the accompanying drawings, in which:

Figure 1 is a schematic view of a plant for implementing the method of the invention;

Figures 2, 3, 4 and 5 are schematic views showing different

rollers used in the preforming stage;

Figure 6 is a schematic view showing the rollers used in the compaction stage.

As can be seen from the figures, the plant for producing yieldable paper comprises essentially a high density kneader 1 consisting substantially of a cylindrical lank 2 with an inverted frusto-conical base and internally housing a conical impeller 3 comprising on its surface a helical projection.

The kneader 1 is connected to a storage vat 4 provided with a stirrer 5 and connected to a beating station 6 formed from beating units 7 of lava disc type alternating with storage chests 8. The exit from the last beating unit 7 is connected to a further high density beating unit 7' of perforated ring type connected to a storage vat 9 communicating with a flow chest 10 feeding a station 11 in which the paper web is formed. This station comprises a cloth 12 taut between two return rollers 13 and arranged to subject the pulp of water and fibrous raw materials to progressive water extraction by means of gravity and vacuum.

The downstream end of the paper web formation station 11 leads to a pressing station 14, downstream of which there are provided an impregnation station 23 and a successive preforming station 15.

Downstream of the preforming station 15 there is provided a drying station 16 of hot roller type which ensures a constant moisture content of the paper web of between 15% and 65%, preferably 50%, and a subsequent compaction station 17 comprising pairs of counter-rotating rollers of different type and surface consistency, driven at different speeds and able to compact the web both longitudinally and transversely.

The exit of the compaction station 17 is connected to a further drying station 18, which is connected to a glazing station 39 connected to a successive paper winding station 19.

The drying station 18 ensures a water content of the paper web of between 4% and 15%, preferably 10%.

The purpose of the glazing station 39 is to improve the printability and bondability characteristics of the yieldable paper obtained and operates with a linear load of between 10 and 100 kg/cm, preferably between 50 and 52 kg/cm.

Between the drying station 18 and winding station 19 there can be inserted a further impregnation station and a further drying station for subjecting the paper web to treatment to improve its printability characteristics, if required.

The plant according to the invention also comprises a

series of controls and automation devices which ensure that the operating cycle is correctly implemented and which will be mentioned as required during the course of the following description.

The operation of the plant according to the invention will now be described with reference to the passage of the paper web under formation through the successive stations.

The bales of fibrous raw material are fed to the high density kneader 1 together with a predetermined quantity of water for their mixing. Here the pulp is kneaded, mixed with water and particular substances added, the purpose of which is to increase the ultimate strength of the fibres, to homogenize the water and fibre pulp and give special characteristics to the paper obtained.

In particular the fibrous raw material consists of vegetable fibres which can be long-fibre cellulose, short-fibre cellulose or other fibres obtained from vegetables other than wood (cotton linters, hemp, flax, esparto, kenaf). The different raw materials can be worked on the same line or preferably on different lines.

Rotating the impeller 3 results in progressive kneading of the fibrous raw material, which preserves the length of the original fibres and results in their intimate mixing with

the water and the additives fed to the kneader. In particular, the additives used can include starches, which are able to bind the fibres together and increase their ultimate strength, or carboxymethyl-cellulose (CMC), the purpose of which is to disperse the fibres and hence prevent their coagulation, or synthetic and/or lactic resins the purpose of which is to bind the fibres together to form a sort of elastic bond.

A pulp of fibre, water and additives leaves the kneader 1 with a dry content of about 15%, this pulp being fed to the successive beating station 6 to be subjected to the action of the lava disc beating units 7, which work the fibres substantially without cutting them, but by hydrating them and conferring particular characteristics on the pulp. As a result of this treatment, the fibres are modified such as to facilitate their consolidation and to form a continuous and homogeneous structure, essential for the characteristics which the final product has to present.

The degree of beating of the pulp can be determined on the basis of objective parameters measured in SR (Shopper Reagler) units, and according to the present invention the pulp leaving the beating treatment must be between 30°SR and 60°SR.

At the exit from the last beating stage the pulp, which as stated is between 30°SR and 60°SR, is fed into the perforated ring beating unit 7', which operates at a density of about 20% and the purpose of which is to hydrate the fibres, to swell and curl them. The pulp is then fed into the storage vat 9 and from here into the flow chest 10, from which with a dray content of about 0,5-1% it is poured onto the underlying cloth 12 of the paper web formation station 11.

On the initial portion of this cloth the pulp tends to progressively eliminate water, firstly by gravity and then by suction, until at the exit end of the cloth it has a dry content of about 18%.

The paper web 20 leaving the station 11 passes to the pressing station 14 between pressing rollers 21 and felts 22, losing water to attain a dry content of about 35%.

The paper web then passes to the impregnation station 23 where it is treated with a solution of various additives the purpose of which is to improve the yieldability characteristics of the paper and/or to improve the production technology. This impregnation is preferably effected by a spray device but can also be effected by other systems, for example by passing the forming paper web through tanks

containing the impregnation solution. In either case the quantity of impregnating substance is controllable, with considerable advantages both in terms of cost of the substance used and in terms of exact determination of said substance.

The web impregnated in this manner is subjected to preforming treatment in the station 15, in which one or more preforming units are provided. These can be all identical or different. In particular, each preforming unit can comprise:

- an upper roller 24 with a shaped profile and a smooth roller 25 with traditional smooth felt 26 (Figure 2);
- a smooth upper roller 27 and a smooth lower roller 28, between which a felt 29 is interposed having an external marking structure to suitably deform the forming paper web interposed between said felt and the upper roller 27 (Figure 3);
- an upper roller 30 with a shaped profile and a smooth lower roller 31 (Figure 4);
- a smooth upper roller 32, a smooth lower roller 33, a traditional felt 34 and a felt 35 of marking structure interposed between the felt 34 and the upper roller 32 (Figure 5).

The use of several preforming units, which can be

identical or different, enables profiles practically of any design to be obtained on the paper web, and in particular designs not obtainable with a single preforming unit.

The paper web preformed in this manner is dried in the station 16 to a dry content of about 50-60% by passage through hot roller or a hot air tunnel, before being subjected to compaction.

In passing from the pressing station 14 to the compaction station 17 the roller speed is regulated so that the paper is subjected to a tension such as to undergo maximum longitudinal elongation compatible with its ultimate strength, in order to obtain transverse contraction of the paper, with a corresponding reserve of transverse yieldability.

Between the preforming station 15 and the drying station 16 there can be interposed a drying and/or fusion station, preferably of infrared type.

In the station 17 the compaction, which occurs both in the longitudinal and in the transverse direction, is effected by passing the paper web between a pair of rollers (Figure 6), of which the lower roller 36 is of rubber and is driven at a certain speed, whereas the upper roller 37 is of metal and comprising a plurality of surface ribs 38, for example

circumferential, and rotates at greater speed. Because of the pressure effect and the configuration of the metal roller 37, cooperating with the rubberized surface of the other roller 36, the paper web is subjected to undulation in the transverse direction and at the same time, because of the different roller speeds, to a braking action by the rubberized roller and to a consequent compaction in the longitudinal direction.

On termination of this compaction stage the paper is subjected to further drying in the station 18 to achieve a dry content of about 85%, preferably 90%.

It should be noted that in passing from the compaction station to the exit of the drying station the roller speed is regulated (substantially constant) such that no traction stress is applied, so that the longitudinally compacted paper loses none of its longitudinal extensibility.

At the exit of the drying station 18 the paper web is subjected to glazing in the station 39.

The paper web obtained in this manner, in particular because of the beating, impregnation, preforming and compaction treatment, presents a high degree of mechanical strength and of yieldability both in the longitudinal direction and in the transverse direction, of the order of at

least 16% transversely and at least 20% longitudinally.

C L A I M S

1. A method for producing yieldable paper, characterised by comprising the following stages:

- feeding a mix of vegetable fibres to a kneader member,
- mixing the mix with water in the kneader,
- beating the fibres by rubbing, to obtain a pulp having a degree of beating of at least 30°SR,
- transferring the beaten pulp into a flow chest,
- feeding the beaten pulp from the flow chest onto a paper web formation cloth with consequent reduction of the water percentage by gravity and vacuum,
- pressing said web, with consequent further reduction of its water content,
- initial drying of the preformed paper web to a substantially constant moisture content of between 15% and 65%,
- compacting between pairs of rollers, of which one is of hard material comprising surface ribs and driven at greater speed, and the other is of soft material with a smooth surface and driven at lesser speed,
- final drying to a moisture content of between 15% and 4%, preferably 10%-8%,
- glazing.

2. A method as claimed in claim 1 characterised in that the glazing stage is carried out with a linear load of between 10 and 100 kg/cm, preferably 50-52 kg/cm.

3. A method as claimed in claim 1 characterised in that the initial drying is carried out until to reach a moisture content of between 45% and 50%.

4. A method as claimed in claim 1 characterised in that after the beating stage a further high density beating stage is carried out.

5. A method as claimed in claim 1, characterised in that before drying the web it is impregnated with additives in solution to increase its yieldability characteristics and to improve its production technology.

6. A method as claimed in claim 1, characterised in that between the impregnation stage and the drying stage the impregnated web undergoes a preforming stage to deform it in accordance with a defined profile which favours the yieldability of the web.

7. A method as claimed in claim 1, characterised in that between the pressing stage and the compaction stage the paper web is subjected to tension such as to undergo maximum longitudinal elongation compatible with its ultimate strength.

8. A method as claimed in claim 1, characterised in that after the compaction stage no longitudinal traction is applied to the paper web, at least until its moisture content has fallen to below 4%.

9. A method as claimed in claim 1, characterised in that the vegetable fibre mix is fed to a high density kneader member.

10. A method as claimed in claim 1, characterised in that beating is effected by rubbing the fibres in a multi-stage unit.

11. A method as claimed in claim 1, characterised in that the fibres leaving the beating stage are stored before being transferred to the flow chest.

12. A method as claimed in claim 1, characterised in that the pressed web is impregnated with additives in solution to improve the subsequent preforming treatment.

13. A method as claimed in claim 1, characterised by using long-fibre cellulose as the vegetable fibres.

14. A method as claimed in claim 1, characterised by using short-fibre cellulose as the vegetable fibres.

15. A method as claimed in claim 1, characterised by using fibre obtained from vegetables other than wood as the vegetable fibres.

16. A plant for implementing the method claimed in one or more of claims 1 to 15, characterised by comprising:

- a kneader (1) for the fibre-based mix,
- a beating station (6),
- a flow chest (10),
- a paper web formation station (11),
- a pressing station (14),
- a drying station (16),
- a compacting station (17),
- a final drying station (18),
- a glazing station (39).

17. A plant as claimed in claim 16, characterised in that an impregnation station (23) is interposed between the pressing station (14) and the drying station (16).

18. A plant as claimed in claim 17, characterised in that a preforming station (15) is provided downtream of the impregnation station (23).

19. A plant as claimed in claim 16, characterised in that the kneader member is of high density type and consists of a cylindrical tank (1) having an inverted frusto-conical base and internally housing a conical impeller (3) comprising a relative helix on its surface.

20. A plant as claimed in claim 16, characterised in that

the beating station (6) is formed from beating units (7) alternating with storage chests (8).

21. A plant as claimed in claim 20, characterised in that the beating units (7) consist of lava discs.

22. A plant as claimed in claim 16, characterised in that a further high density beating station (7') of perforated ring type is provided downstream of the beating station (6).

23. A plant as claimed in claim 16, characterised in that the paper web formation station (11) comprises a cloth (12) taut between return rollers (13) and arranged to subject the pulp of water and fibrous raw materials to progressive water extraction by gravity and/or by vacuum.

24. A plant as claimed in claim 16, characterised in that the pressing station (14) comprises pressing rollers (21) and felts (22).

25. A plant as claimed in claim 16, characterised in that the impregnation station (23) consists of at least one tank containing an impregnating solution.

26. A plant as claimed in claim 16, characterised in that the impregnation station (23) comprises elements for spraying the impregnating solution onto the paper web (20).

27. A plant as claimed in claim 16, characterised in that the preforming station (15) comprises at least one preforming

unit.

28. A plant as claimed in claim 27, characterised in that the preforming unit comprises an upper roller (24) of shaped profile and a smooth lower roller (25) with traditional smooth felt (26).

29. A plant as claimed in claim 27, characterised in that the preforming unit comprises a smooth upper roller (27) and a smooth lower roller (28), between which there is interposed a felt (29) having an external marking structure.

30. A plant as claimed in claim 27, characterised in that the preforming unit comprises an upper roller (30) of shaped profile and smooth lower roller (31).

31. A plant as claimed in claim 27, characterised in that the preforming unit comprises a smooth upper roller (32), a smooth lower roller (33), a traditional felt (34) and a felt (35) of external marking structure interposed between the felt (34) and the lower roller (33).

32. A plant as claimed in claim 16, characterised in that the drying station (16) comprises an infrared heater.

33. A plant as claimed in claim 16, characterised in that the drying station (16) comprises a plurality of hot roller.

34. A plant as claimed in claim 16, characterised in that the drying station (16) comprises a hot air tunnel.

35. A plant as claimed in claim 16, characterised in that the compaction station (17) comprises a pair of roller (36, 37), of which the lower roller (36) is of rubber and driven at a certain speed, while the upper roller (37) is of metal comprising a plurality of surface ribs (38) and rotates at greater speed.

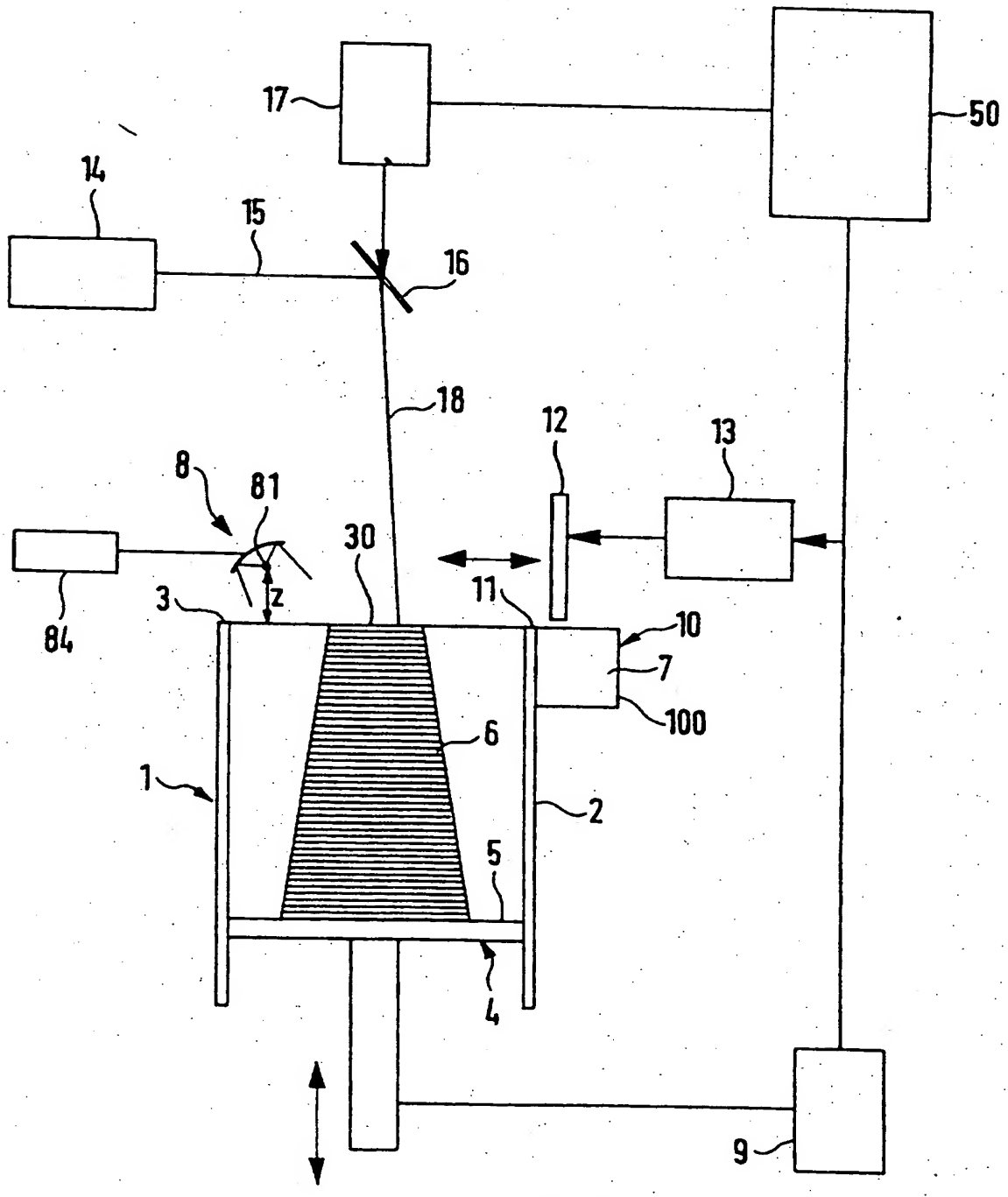


FIG. 1

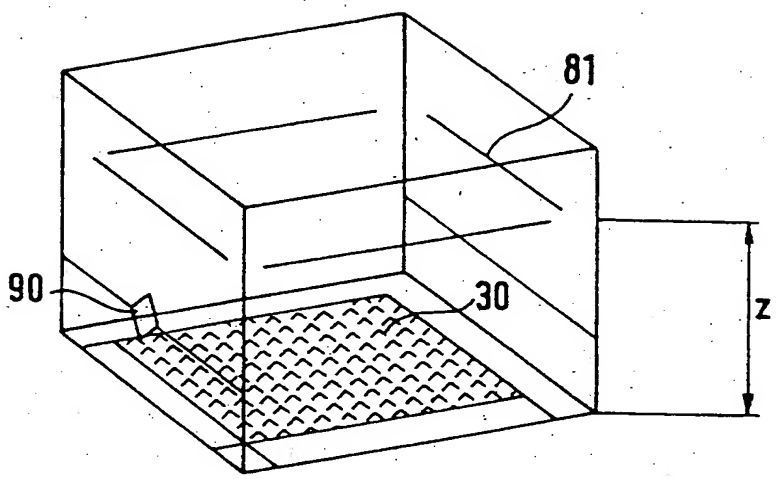


FIG. 2

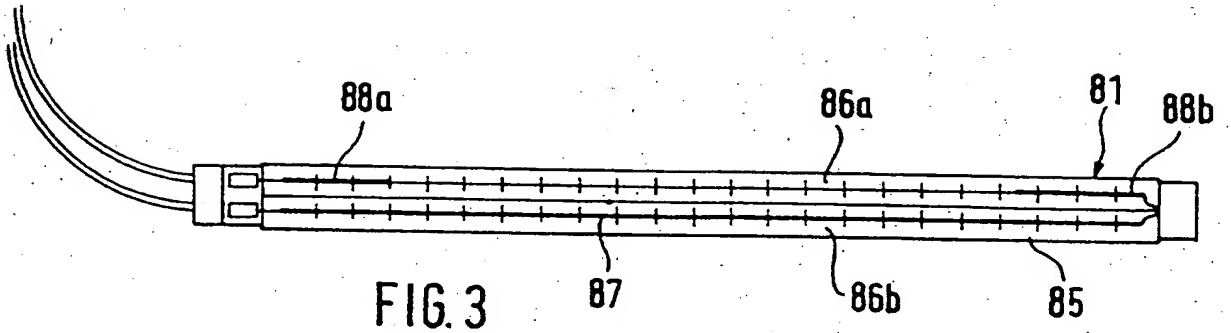


FIG. 3

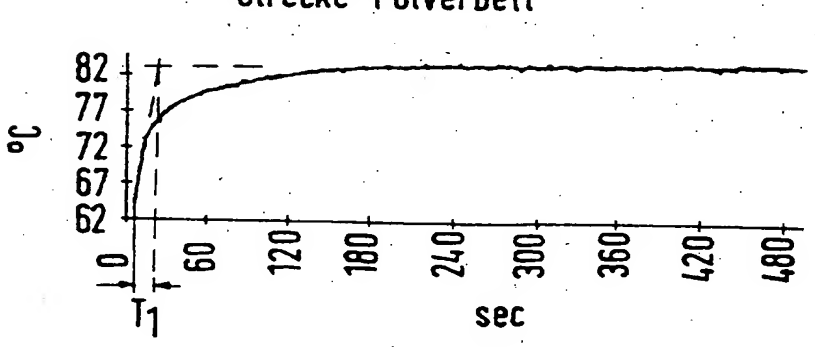


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 96/01484

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21F11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21F D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US,A,3 454 463 (H.S. WELSH) 8 July 1969 see abstract; figure 1	16 1-3,24, 33
A	US,A,3 290 209 (C.B.A. IHRMAN) 6 December 1966 see column 1, line 59 - column 2, line 24; figures 1,3	1,35
A	EP,A,0 568 404 (KIMBERLY-CLARK CORPORATION) 3 November 1993 see page 6, line 16 - line 42; figure 4	1,4,16, 19,22
A	EP,A,0 631 014 (KIMBERLY-CLARK CORPORATION) 28 December 1994 see page 4, line 54 - page 5, line 2 see page 5, line 14 - line 50	1,5, 13-16

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 August 1996	09. 09. 96

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Schmitt, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 96/01484

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,94 08089 (JAMES RIVER UK HOLDINGS LTD) 14 April 1994 see page 2, paragraph 3 - page 3, paragraph 3; figure 2 -----	6,18,23, 27-31

1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 96/01484

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-3454463	08-07-69	BE-A-	701079	18-12-67
		DE-A-	1696176	16-12-71
		FR-A-	1519019	10-07-68
		GB-A-	1134675	
		NL-A-	6704845	15-01-68
		SE-B-	340947	06-12-71
US-A-3290209	06-12-66	DE-B-	1211918	
		GB-A-	1033228	
EP-A-568404	03-11-93	US-A-	5348620	20-09-94
		CA-A-	2076731	18-10-93
		CA-A-	2091096	18-10-93
		US-A-	5501768	26-03-96
		AU-B-	4899793	30-06-94
		BR-A-	9304733	02-08-94
		CN-A-	1091173	24-08-94
		JP-A-	6184977	05-07-94
EP-A-631014	28-12-94	AU-B-	7243894	17-01-95
		CA-A-	2103342	25-12-94
		FR-A-	2708453	10-02-95
		FR-A-	2715047	21-07-95
		FR-A-	2715048	21-07-95
		FR-A-	2715049	21-07-95
		FR-A-	2715050	21-07-95
		FR-A-	2715175	21-07-95
		GB-A-	2279372	04-01-95
		WO-A-	9500706	05-01-95
WO-A-9408089	14-04-94	GB-A-	2270931	30-03-94
		AU-B-	667626	28-03-96
		AU-B-	6136294	26-04-94
		EP-A-	0662171	12-07-95

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☑ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.